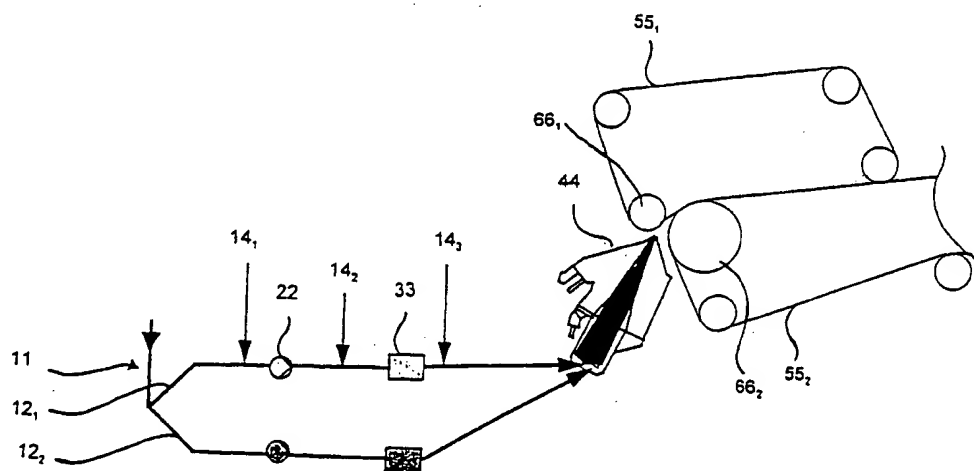


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>D21F 11/00</b>	<b>A1</b>	(11) International Publication Number: <b>WO 99/40256</b> (43) International Publication Date: <b>12 August 1999 (12.08.99)</b>
<p>(21) International Application Number: <b>PCT/FI99/00075</b></p> <p>(22) International Filing Date: <b>3 February 1999 (03.02.99)</b></p> <p>(30) Priority Data: <b>980287</b> <b>9 February 1998 (09.02.98)</b> <b>FI</b></p> <p>(71) Applicant (for all designated States except US): <b>VALMET CORPORATION [FI/FI]; Panuntie 6, FIN-00620 Helsinki (FI).</b></p> <p>(72) Inventors; and</p> <p>(75) Inventors/Applicants (for US only): <b>KINNUNEN, Juha, S. [FI/FI]; Hauhontie 35 A 4, FIN-40520 Jyväskylä (FI). KORHONEN, Hannu [FI/FI]; Suluntie 26 B 9, FIN-40340 Jyväskylä (FI). RÄISÄNEN, Kari, Olavi [FI/FI]; Likolammekatu 3 F 53, FIN-33300 Tampere (FI). VIERTOLA, Mika [FI/FI]; Hukkaperä 2 B 6, FIN-40400 Jyväskylä (FI).</b></p> <p>(74) Agent: <b>FORSSÉN &amp; SALOMAA OY; Yrjönkatu 30, FIN-00100 Helsinki (FI).</b></p>	<p>(81) Designated States: <b>AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</b></p> <p><b>Published</b></p> <p><i>With international search report.</i></p> <p><i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>	

(54) Title: APPLICATION OF A LAYER OF ADMIXTURE IN THE WEB FORMER UNIT OF A BOARD MACHINE



## (57) Abstract

The invention concerns a method for application of a layer of admixture in the web former unit of a board machine. The flow of fresh stock (11) is divided into at least two component stock flows (12<sub>1</sub> and 12<sub>2</sub>), of which flows, to at least one component flow (12<sub>1</sub>), which forms a face which will be placed against the face of the layer to be combined with it, at a point (14<sub>1</sub>) before the pump (22), at a point (14<sub>2</sub>), and/or at a point (14<sub>3</sub>) after the machine screen, admixtures are added in order to increase the contents of fines in the layers and the bonding strength between the faces, and after this the component flows (12<sub>1</sub> and 12<sub>2</sub>) are passed into the multi-layer headbox (44) and further into the gap former.

*FOR THE PURPOSES OF INFORMATION ONLY*

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Larvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakhstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

Application of a layer of admixture in the web former  
unit of a board machine

5

The invention concerns a method for application of a layer of admixture in the web former unit of a board machine.

- 10 As is well known, board is almost always made of two or more separate layers. In such a case, the webs formed by two or more wire parts are combined one on top of the other before the press section. In the case of webs produced by means of a conventional fourdrinier wire technique, combining of the surface sides of the webs that are not in contact with the wire does, as a rule, not involve problems, and in
- 15 such a case the strength between the layers in the Z-direction of the web thus obtained, i.e. the "ply bond", is usually adequate. However, when the conventional fourdrinier wire technique is employed, the running speeds are clearly lower than 1000 metres per minute. As the running speeds of the present-day, newer board machines rise to a level higher than 1000 metres per minute, it is necessary to
- 20 employ other techniques, for example the gap former technique. In such a case, it becomes a problem that the combination of two or more webs formed in a gap former does not meet the requirements of strength that have been imposed. The bond strength between the different layers in the web is reduced. What is concerned in particular is the Z-direction strength represented by the what is called "scott bond".
- 25 The poor strength is contributed to by an inadequate concentration of fines on the faces of the layers to be combined. An adequate concentration of fines on the faces to be combined promotes the ply bond between the faces. It has proved problematic to produce board by means of a machine in which the so-called wire sides are combined one against the other. This would be the case always if all the web
- 30 formers were gap formers. This problem sometimes also occurs in combining of webs formed both by means of a hybrid former and by means of a fourdrinier wire.

Attempts have been made to solve the problem, among other things, by spraying starch as a solution or by spraying some other auxiliary agent that increases the bond strength directly onto the web or by introducing a thin layer of extensively ground cellulosic pulp, for example, from a separate headbox, i.e. from a secondary  
5 headbox, onto one of the webs to be combined. One mode has been to grind the stock to be passed to one of the layers to an extent clearly higher than normal.

In the following, some prior-art solutions will be described in more detail.

10 In the *FI Patent No. 71,377*, a method for manufacture of multi-layer board is described, in which method the stock suspension that forms one of the surface layers is fed onto the horizontal portion of the first wire. Between the layers, a third stock suspension, which forms the intermediate layer, is fed, ahead of the wedge-like gap that is formed by the second wire, onto the web layer that was already formed. After  
15 this, the first wire and both of the web layers are passed into contact with the third wire, onto whose horizontal portion the stock suspension is fed which forms the other surface layer. The consistency of the stock suspension that forms the intermediate layer is considerably higher than the consistencies of the stock suspensions that form the surface layers.

20

In the *US Patent No. 5,607,555*, a paper machine for manufacture of multi-layer paper is described. In this machine, there are at least two twin-wire formers, which produce a multi-layer paper web, in which connection a paper is obtained whose properties on both faces are equal.

25

In the *Finnish Patent No. 92,729*, a stock feed system for a multi-layer headbox and a method in the operation of a multi-layer headbox are described. In this solution, into each inlet header in the multi-layer headbox, a stock produced out of the same fresh stock is introduced, to which stock the necessary chemicals and fillers have  
30 been added.

The prior-art solutions, however, involve a number of significant drawbacks. A separate headbox that sprays starch or fibre stock is an expensive solution, and its use is confined to relatively low speeds, which remain lower than 1000 metres per minute. The starch jets deteriorate the runnability considerably, they block the wires and felts and contaminate the machines, in which case the equipments have to be stopped and cleaned rather frequently. Thus, the necessary auxiliary agents cannot be added selectively either. In most systems, a number of separate stock lines are needed, in which case the system is rather heavy and expensive to operate. Grinding of one of the stock layers deteriorates the draining of water clearly, and thereby it deteriorates the runnability and the efficiency of production and increases the costs. In an attempt to attain speeds higher than 1000 metres per minute, such restrictions cannot be tolerated, and a separate jet of admixture that promotes the binding together of the different layers would not be even possible at these speeds.

15 The method in accordance with the invention for application of a layer of admixture in the web former unit of a board machine, the method for manufacture of board, and the board are mainly characterized in what is stated in the patent claims.

20 The invention will be described in the following in more detail with reference to some preferred embodiments of the invention illustrated in the figures in the accompanying drawings, the invention being, however, not supposed to be confined to said embodiments alone.

25 Fig. 1 illustrates a preferred embodiment of the invention, which is in particular suitable for manufacture of board and in which the stock flow produced out of the same fresh stock is divided into two component flows. To the face that will be placed against the face of the layer to be combined, the necessary admixtures are added in order to increase the fines content in the layer and to promote the bond strength between the faces to an optimal extent at an optimal point. The component flows are passed into a multi-layer headbox and from it into a gap former. In this way, good properties of formation and strength and good internal bond strength are obtained for the board. Thus, out of the same fresh stock 11, two component flows

30

12<sub>1</sub> and 12<sub>2</sub> are produced. To the component flow 12<sub>1</sub>, out of which the face will be formed that will be placed against the face of the layer to be combined, at the point 14<sub>1</sub> before the pump 22, at the point 14<sub>2</sub> after the pump 22, and/or at the point 14<sub>3</sub> after the machine screen 33, the admixtures are added in order to increase the fines content in the layer and the bond strength between the faces. After this the component flows 12<sub>1</sub> and 12<sub>2</sub> are passed into the multi-layer headbox 44, which comprises, in the conventional way, inlet headers, a tube manifold connected with each inlet header, an intermediate chamber connected with the tube manifold, a turbulence generator and turbulence tubes, a slice cone after the turbulence generator, and vanes that separate the layers in said slice cone. From the headbox the web is transferred into the former, in which 55<sub>1</sub> represents the first forming wire, 55<sub>2</sub> the second forming wire, 66<sub>1</sub> represents a former roll, and 66<sub>2</sub> the forming roll.

Fig. 2 illustrates a second preferred embodiment of the invention, in which the stock flow produced out of the same fresh stock is divided into three component flows, of which flows, onto the faces that will be fitted against the faces of the layers to be combined, the necessary admixtures will be added in order to increase the fines contents in the layers and to promote the bond strength between the faces to an optimal extent and at an optimal point. After that, the component flows are passed into a multi-layer headbox and further into a gap former. In this solution, out of the same fresh stock 11, three separate component flows 12<sub>1</sub>, 12<sub>2</sub> and 12<sub>3</sub> are formed. To the faces that are formed on the component flows 12<sub>1</sub> and 12<sub>3</sub> and that will be placed against the faces of the layers to be combined, at the points 14<sub>1</sub> before the pumps 22<sub>1</sub> and 22<sub>3</sub>, at the points 14<sub>2</sub> after the pumps 22<sub>1</sub> and 22<sub>3</sub>, and/or at the points 14<sub>3</sub> after the machine screens 33<sub>1</sub> and 33<sub>3</sub>, the admixtures are added in order to increase the fines contents in the layers and the bond strength between the faces. After this the component flows 12<sub>1</sub>, 12<sub>2</sub> and 12<sub>3</sub> are passed into the multi-layer headbox 44 and further into the gap former. As an alternative solution, the admixtures can be added to one component flow 12<sub>1</sub>, 12<sub>2</sub> or 12<sub>3</sub> only.

Fig. 3 shows a preferred combination in accordance with the invention, in which the layer 13 that contains an admixture and that is to be combined is introduced through

a twin-layer headbox  $44_1$  into a gap former, and the web thus obtained is combined with a second web, which is derived from a normal headbox  $44_2$  and from a second gap former. The numeral  $55_1$  represents the first forming wire,  $55_2$  the second,  $55_3$  the third, and  $55_4$  represents the fourth forming wire.

5

Fig. 4 shows a second preferred combination in accordance with the invention, in which the layers  $13_1$  and  $13_2$  that contain an admixture and that are to be combined are introduced into two separate multi-layer headboxes, herein twin-layer headboxes  $44_3$ ,  $44_4$ , and the webs that contain admixtures are passed into gap formers and then  
10 combined with each other. When two layers that contain admixtures are combined, a stronger bonding layer is obtained, which is necessary in applications that require higher strength.

Fig. 5 shows a solution in which the outermost layers  $13_3$  and  $13_4$  of a three-layer  
15 headbox  $44_5$ , which outer layers contain admixtures, operate as bonding layers, with which the stock layers derived from two normal headboxes  $44_6$  and  $44_7$  are combined. The numerals  $55_1 \dots 55_6$  represent the forming wires.

In the solutions in accordance with the invention, it is an essential feature that in the  
20 manufacture of board it is possible to employ a gap former in a multi-layer technique at high speeds of levels higher than 1000 metres per minute. In such a case, the admixture that increases the fines content and/or the bond strength is applied as a layer onto the face that will be placed against the face of the layer to be combined. Thus, a higher fines content is obtained on the face that will be placed, for example,  
25 against the face of a middle layer, in which connection the binding strength and the internal bond strength between the layers are increased. When the solution in accordance with the invention is employed in a 3-layer headbox, it is preferable to feed the admixtures onto the outermost faces. The agents that can be applied in this way as layers are starch, fillers, fines, retention agents, such as polyacrylamide,  
30 polyacrylimide, special chemicals, hydrophobifying sizes, and equivalent. In this solution it is also favourably possible to use the same fresh stock and one basic stock line. Further, it is possible to amend the poor properties of a gap former, to improve

the runnability and to help the machine to remain clean. In the solution in accordance with the invention, the distribution of the fibre-based fines, fillers and starch in the surface, frame and/or bottom layers of the board is regulated so that the concentration of said agents is higher at the face that will be placed against the middle layer. The amount of admixture can be optimized, and so also the location at which it is added, in which way an optimal bond between the layers is obtained. This is also reflected in the printing quality of the product. The admixture or admixtures can be applied as layers on the face to be combined only, or alternatively also on several layers consisting of component flows.

10

By means of the invention, the face of the web to be combined that will enter into contact with a second web can be made favourably in view of the bond strength. Thus, said face is already formed in the headbox such that it is favourable in view of bonding properties by means of fines or concentration of starch or equivalent. By means of the order and amount of adding, it is also possible to have a substantial effect on the properties that are desirable in the product or in the process. Besides the application of admixtures as layers in the way described in the present invention, of course, it is also possible to carry out conventional metering of admixtures in the normal way. Since the present invention permits the use of gap formers in the manufacture of board in stead of the conventional fourdrinier wire technique, no large wire pit is needed, the equipment requires less space, it is possible to use smaller amounts of water, fewer dewatering elements, and it is also possible to run at a higher consistency than in the case of a fourdrinier wire. The method in accordance with the present invention can be employed both in an upper-wire unit and on the what is called frame layer. In the manufacture of some special products, this method can also be substituted for a secondary headbox altogether.

20

25



## Claims

1. A method for application of a layer of admixture in the web former unit of a board machine, **characterized** in that the flow of fresh stock (11) is divided into at least two component stock flows ( $12_1$  and  $12_2$ ), of which flows, to at least one component flow ( $12_1$ ), which forms a face which will be placed against the face of the layer to be combined with it, at a point ( $14_1$ ) before the pump (22), at a point ( $14a_2$ ), and/or at a point ( $14_3$ ) after the machine screen, admixtures are added in order to increase the contents of fines in the layers and the bonding strength between the faces, and after this the component flows ( $12_1$  and  $12_2$ ) are passed into the multi-layer headbox (44) and further into the gap former.
2. A method as claimed in claim 1, **characterized** in that the admixture includes starch, fines, fillers, retention agents, hydrophobifying sizes, and special chemicals.
3. A method as claimed in claim 1 or 2, **characterized** in that the fresh stock flow (11) is branched into three separate component flows ( $12_1, 12_2, 12_3$ ), of which flows the admixtures are added to at least one component flow ( $12_1$ ).
4. A method as claimed in any of the claims 1 to 3, **characterized** in that the application of a layer of admixture takes place in an upper-wire unit.
5. A method for manufacture of board, **characterized** in that at least one layer in at least one multi-layer headbox includes an admixture, the web is passed from the multi-layer headbox through a gap former and combined with at least one web, which is derived from a second combination of a multi-layer headbox or a normal headbox and a gap former.
6. A board, **characterized** in that the board comprises a layer of admixture that has been prepared by means of at least one multi-layer headbox.

7. A board as claimed in claim 6, **characterized** in that the admixture includes starch, fines, fillers, retention agents, hydrophobifying sizes, and special chemicals.

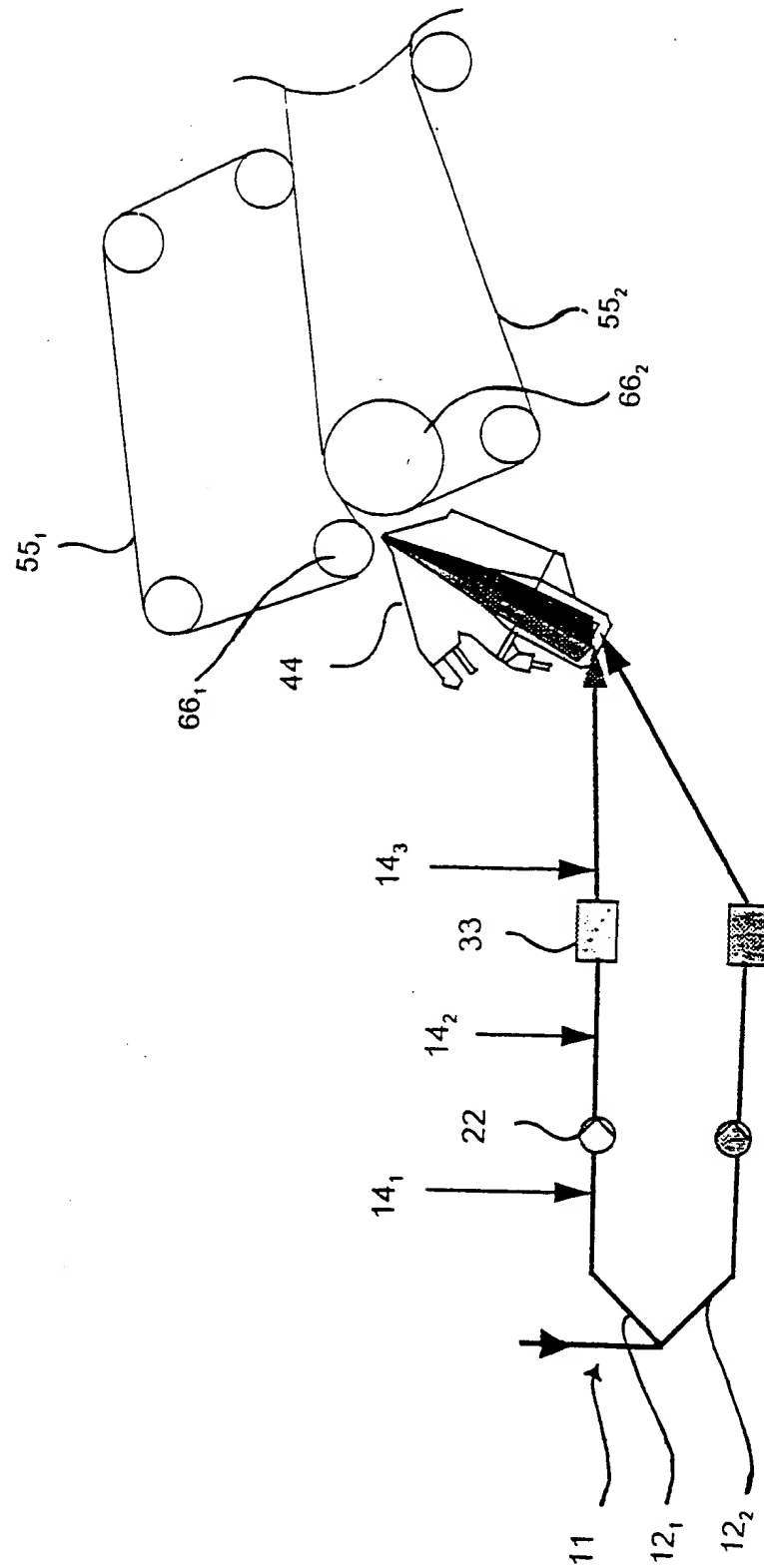


Fig. 1

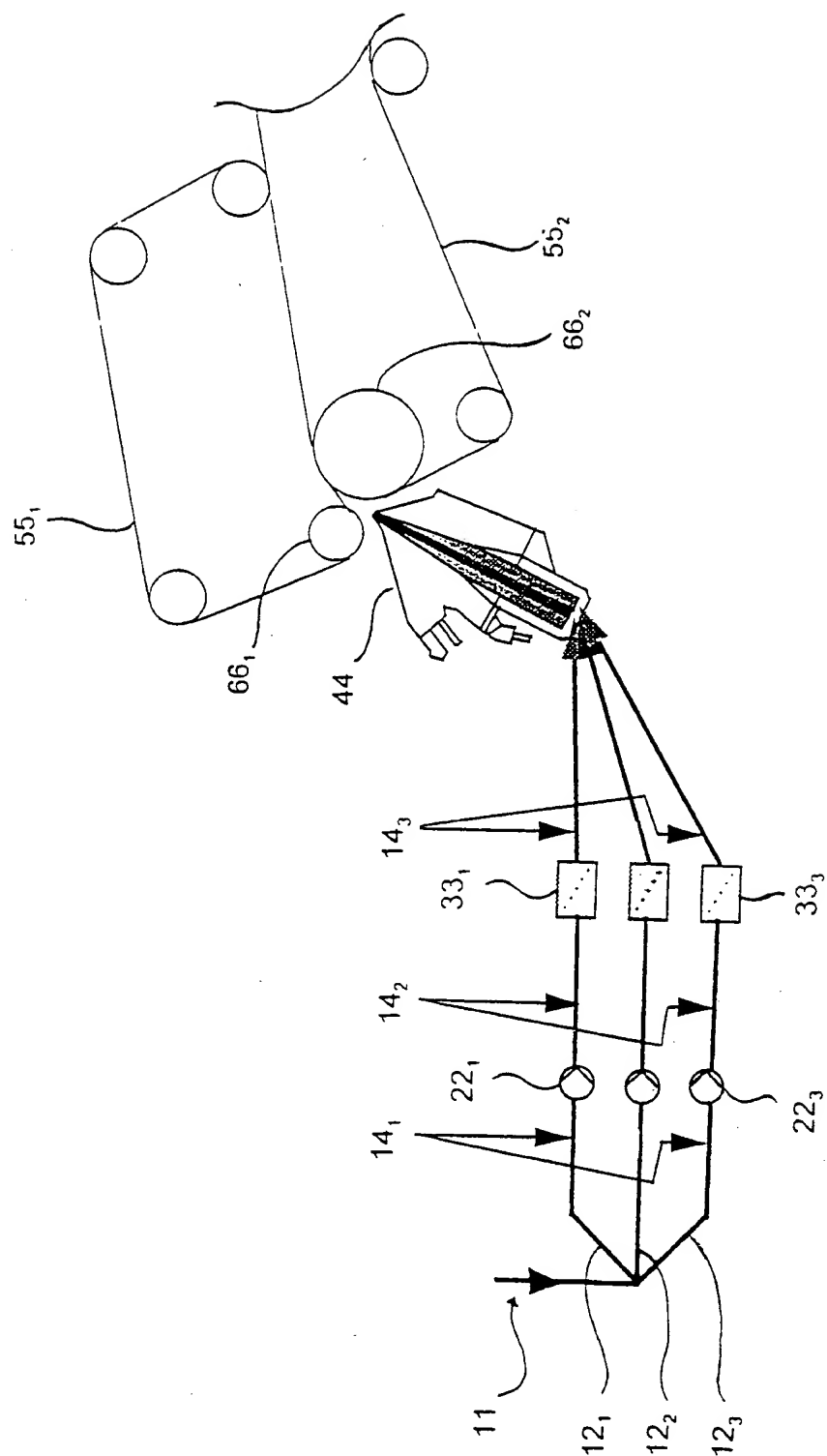


Fig. 2

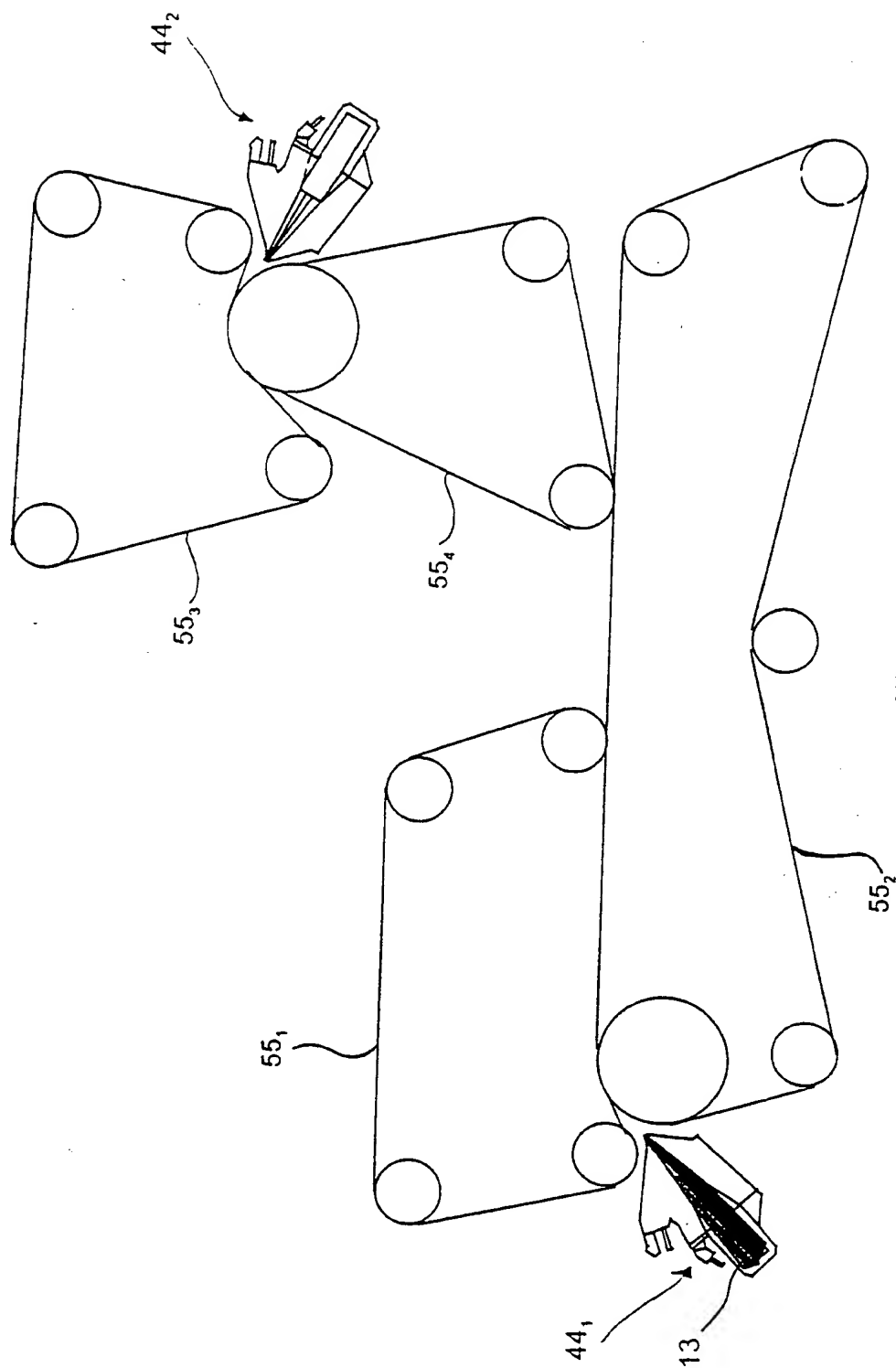


Fig. 3

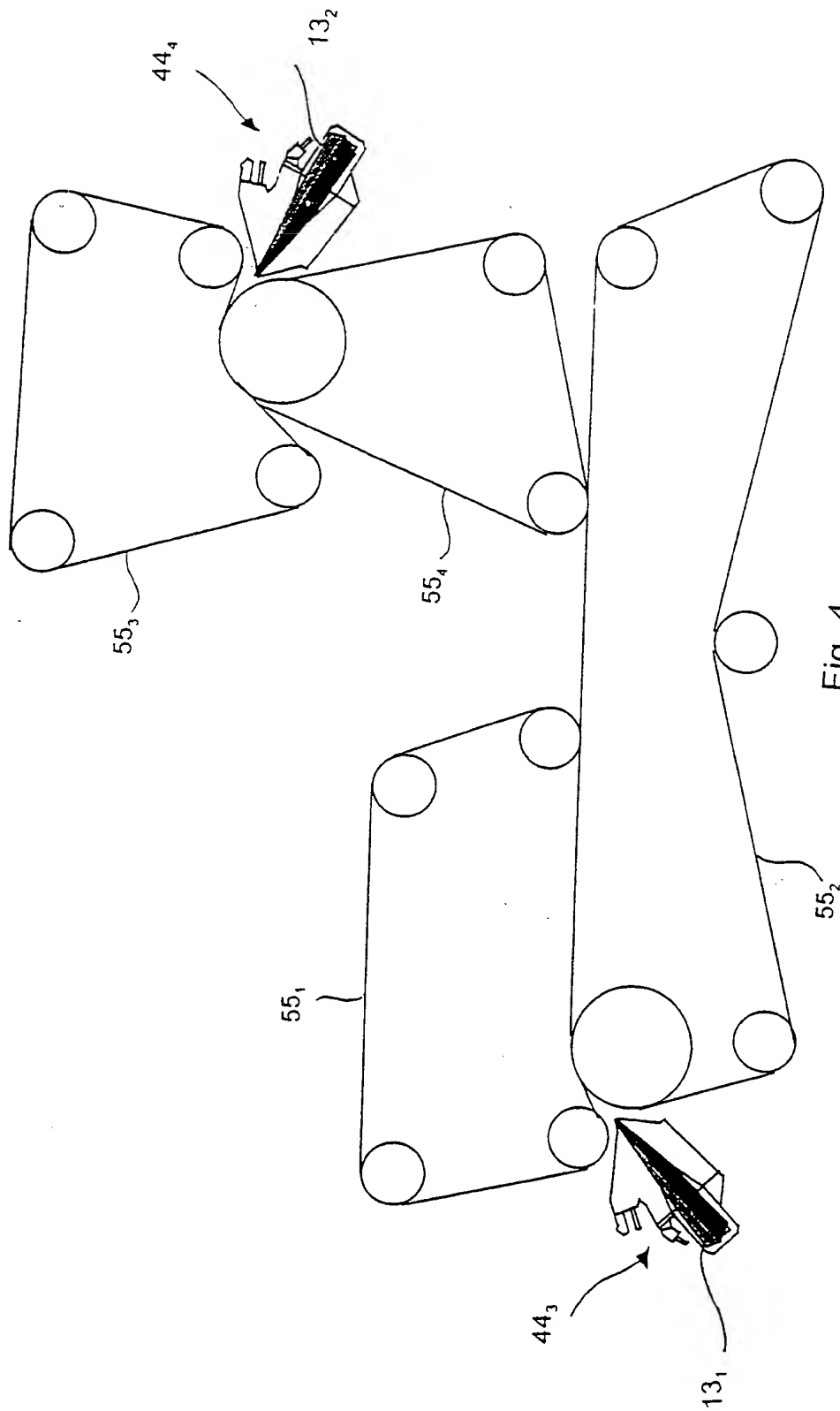


Fig. 4

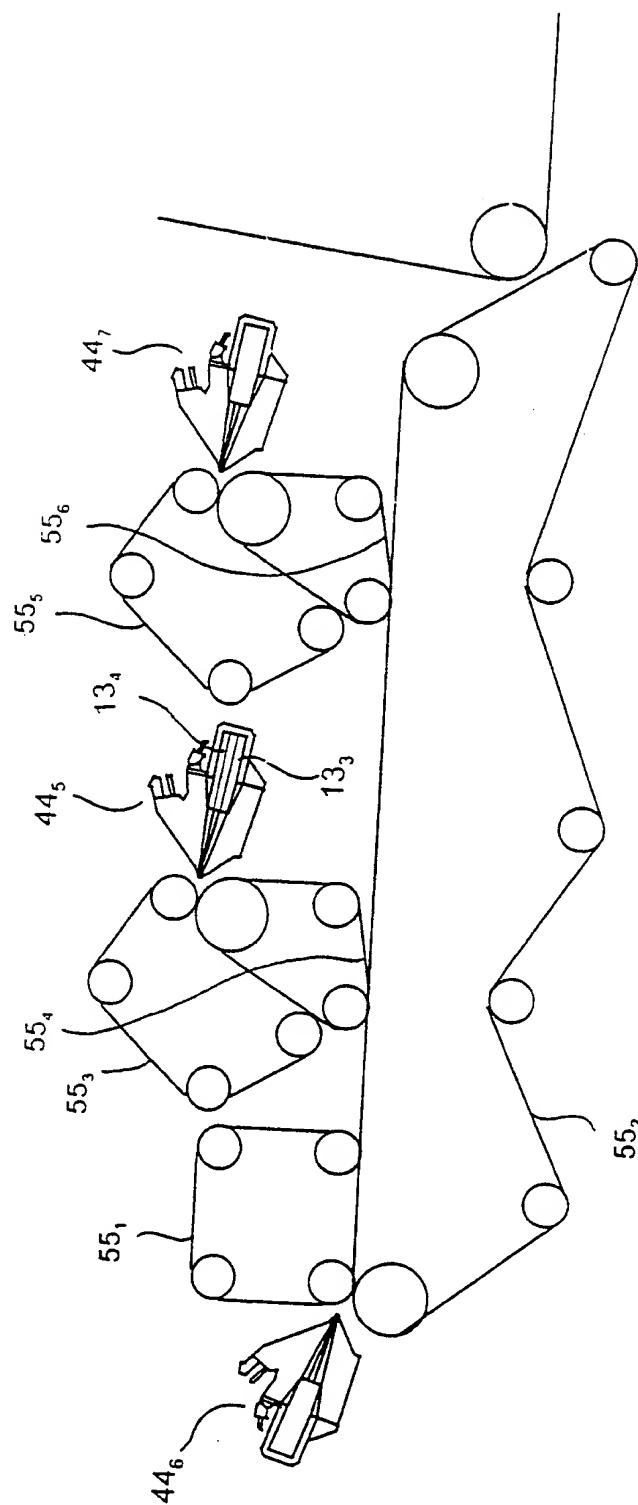


Fig. 5

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 99/00075

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: D21F 11/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0651092 A1 (VALMET PAPER MACHINERY INC.), 3 May 1995 (03.05.95), column 2, line 28 - line 35; column 3, line 41 - line 48, figures 1,2  -----	1-3

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

26 May 1999

Date of mailing of the international search report

01-06-1999

Name and mailing address of the ISA/

Swedish Patent Office

Box 5055, S-102 42 STOCKHOLM

Facsimile No. +46 8 666 02 86

Authorized officer

Olav Jensen

Telephone No. +46 8 782 25 00



# INTERNATIONAL SEARCH REPORT

Information on patent family members

03/05/99

International application No.

PCT/FI 99/00075

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
---	---------------------	----------------------------	---------------------

EP 0651092 A1

03/05/95

SE 0651092 T3

AT 168424 T

15/08/98

CA 2134492 A

30/04/95

DE 69411663 D,T

28/01/99

FI 92729 B,C

15/09/94

FI 934793 D

00/00/00

